XXVIII.—*Contributions to the Anatomy of the Infusoria**. By N. Lieberkuhn.

The essential characters, discernible by direct observation, assigned by Ehrenberg to the genus *Ophryoglena*, are, that the mouth and the anal point do not lie at the same end of the body; that the body bears cilia over the whole surface, and that a forehead-eye exists; and, more particularly, "the mouth is a pit below the forehead, and the anal point is observed on the back at the base of the tail."

Of the three species, *Ophryoglena atra, acuminata* and *flavicans*, the latter is thus described:—*O.* corpore flavicante, ovato, turgido, postico fine attenuato obtuso, ocello rubro frontali. Size $\frac{1}{12}$th of a line. It is added of *O. flavicans*,—"It resembles a *Bursaria*, and I only distinguish it from this by the eye-spot, hitherto unknown in the family, the physiological importance of which I established. The cilia of the mouth are longer than in the preceding species. The mouth, passing away from the forehead, forms a deep pouch, and near this there always exists a light, but not so distinct, spot as in the preceding species." It was made to take in indigo.

During last winter and spring, I frequently found in the water of the Spree, where Spongillæ were present, an Infusorium which shares the essential peculiarities of *Ophryoglena flavicans*, and manifests, in addition, some hitherto unknown. Its yellowish body is entirely covered with cilia; the cilia are placed in longitudinal rows; it is ovate, attenuated towards the posterior extremity, without becoming prolonged into a point. At the part called by Ehrenberg the forehead (*Stirn*), it bore a pigment-spot varying from brown-red to dark brown, situated close by the mouth, which formed a deep pouch. According to Ehrenberg, the spot is not always so distinct as in the other species, and the animalcule in question likewise exhibits this irregularity: the pigment-spot of *Ophryoglena atra*, which I found frequently in the stagnant water near Pichelsberg, is ordinarily more distinct. The inconstancy of the colour of the eye-spot of our Infusorium affords no essential distinction, if we entertain Perty's statement, that the pigment-spot of *Ophryoglena griseovirens* is reddish in young specimens and blackish in old ones (Perty, zur Kenntniss kleinster Lebensformen in der Schweiz, p. 142).

The animalcule I observed differs in size, which amounted to $\frac{1}{4}$th of a line, and also in the constant presence of two contractile vesicles; for Ehrenberg ordinarily saw only one, rarely two,

* Translated from Müller's Archiv, January 1856.

which he regarded as indicative of the commencement of division.

The animalcule took up abundance of indigo. I did not see any excretion of substances, and hence I cannot state anything about an anal point; no special orifice was visible.

The presence of an eye-spot, the position of the mouth, the complete investment of the body with cilia, require the assignment of the animalcule to the *Ophryoglenæ*; and the described form of its body, its colour, the peculiar pouch-like form of the mouth, the variability of the distinctness of the pigment-spot,—all these make it appear warrantable to name the animalcule *Ophryoglena flavicans*, until more certain distinctive characters have been discovered. The following notices regarding it relate more particularly to the existence of a hitherto unobserved watch-glass-like organ near the pigment-spot, and to the vascular system.

The Eye-spot and the watch-glass-like Organ.

In order to describe accurately the position of these organs, it is necessary previously to give a more particular account of the mouth of the animalcule. The mouth forms a narrow slit in the form of a semicircular line, and lies in a small depression. In a large specimen, measuring $\frac{6}{10}$ths of a millimetre in length and $\frac{14}{100}$ths of a millimetre in breadth, the distance of the upper point of the mouth from the end of the head was $\frac{1}{10}$th of a millimetre, of the lower from the upper point of the mouth $\frac{24}{1000}$ths of a millimetre. The oral cilia, placed all round the margin of the slit, are far longer than the cilia of the rest of the body, although these are also remarkable for length; the cilia of the mouth are seen to project far beyond the others when the animalcule lies so that the mouth is on the outline of its figure. The oral slit leads directly into a sac-like space, which may be traced for a short distance into the cavity of the body, whenever the latter is not filled up with the strongly refractive granules; we may also then detect a membrane constantly vibrating backwards and forwards in the interior of the sac. But this part ordinarily only becomes distinctly visible when the oral portion, with the pouch, has been isolated by the compression of the animalcule; the mouth is the entry into the pouch; at the opposite side is an orifice, through which substances which have been taken in by the mouth are conducted further. Near to this is attached the vibrating membrane, and it is fixed by one angle to the internal wall of the sac, while the other parts project freely into the cavity of the latter. That it is not merely an apparently undulating membrane, as Stein correctly asserted of the ciliary wreath of the Trichodinæ, is at once ascertained by compressing the isolated oral structure while the membrane still vibrates.

Close by the oral slit, on its concave side, lies the pigment-spot. Its form is extremely irregular, sometimes globular, sometimes ellipsoidal, in many cases toothed. Ordinarily it is so distinct as to be at once perceived; sometimes, however, it is so small that it can only be detected by close examination. In animalcules filled with strongly refracting substances alone, it is always difficult to discover it. The pigment-spot of *Ophryoglena atra* has, on the whole, more uniformity of form and magnitude. If we squeeze down an *Ophryoglena flavicans* between the covering glass and the slider, we find that the pigment-spot is composed of a heap of minute, scarcely measurable granules, strongly refracting light. I never could discover a lens in the pigment. All the specimens examined by me possessed but a single pigment-spot. Beside this lies always a hitherto unobserved structure, the form of which is perfectly described when we call it a watch-glass on a small scale. This watch-glass-like organ is transparent and colourless, and shows no trace of fibrous or any other structure. The circular base has a diameter of about $\frac{1}{100}$th of a millimetre; its depth amounts to about a third part of this diameter; the convexity is very considerable. The watch-glass-shaped organ usually turns its convex side towards the pigment-spot; its concave side is directed towards the point of the head; it does not seem to be moveable by the animalcule. When isolated, it withstands the action of water for a longer time than is usually the case with the other parts of the body of this Infusorium. After lying some time in water, it swells up in some degree, and frequently becomes perforated by a hole in the middle. The presence of the watch-glass-shaped organ is not dependent on the presence of a pigment-spot; for *Ophryoglena atra* possesses a pigment-spot, but no watch-glass-shaped organ, while *Bursaria flava* has a watch-glass-shaped organ, but no pigment-spot. In other Infusoria with eye-spots, as in the *Euglenæ* and *Peridinia*, I have sought in vain for this organ. I have not met with any facts throwing light on its function.

The Nucleolus.

This structure, first described by Von Siebold in *Loxodes Bursaria*, and subsequently observed by Stein in *Prorodon*, is properly the only part, except the eye-point, which distinguishes the *Ophryoglena* in question from *Bursaria flava*,—at least in all the specimens which I have hitherto observed. These two animalcules stand, on the whole, much nearer together than *Bursaria leucas* and *Ophryoglena atra*, which resemble each other very much in form and in the structure of the mouth; Ehrenberg himself, too, has said, that he only distinguished *Ophryoglena flavicans* from a *Bursaria* by its eye-spot. *Bursaria flava,* which I found in great numbers, in spring and summer, in stagnant water in the Berlin Thiergarten, has the same structure of the mouth, the same throat-like prolongation, and the same undulating membrane as *Ophryoglena flavicans;* the watch-glass-shaped organ also stands in the same place, near the concave side of the mouth, and likewise regularly has its convexity directed towards the point of the head; the only difference is a slightly larger size, the diameter of the base amounting to $\frac{15}{1000}$ths of a millimetre, when the animalcule did not exceed $\frac{1}{4}$ of a millimetre in length. In the interior of the body frequently occur long, yellow-ochre-coloured globular granules, about $\frac{1}{100}$th of a millimetre in diameter, rendering the animalcule opake; among these were isolated colourless spheroidal cavities, like those which Ehrenberg describes in *Bursaria flava.* I could not find an anal orifice; but sometimes there was at the posterior extremity of the body a light spot and a depression, which Ehrenberg refers to the anal orifice. I found the form of the body to agree exactly with that of *Bursaria flava* as figured by Ehrenberg, as did also the position of the contractile vesicle; so that Ehrenberg's description exactly applied: "*Bursaria* corpore ovato-oblongo, flavo, sæpe postica parte paullo tenuiore, subacuto, ore corporis aliqua parte superato."

Let us now return to the description of the nucleolus in *Ophryoglena flavicans.* As this animalcule usually contains in its interior extremely few, and at the same time minute granules of strong refractive power (in rare cases I found them like those which occur in *Bursaria flava*), the internal structures are generally readily perceived. The nucleolus is shaped like a grain of barley, and is marked at each end with a few sharply defined streaks or furrows; its length is somewhat more than $\frac{2}{100}$ths of a millimetre, its thickness in the middle about $\frac{1}{100}$th of a millimetre. Its substance has a stronger refractive power than that of the rest of the body, but far less than the fat-like globules. Under the highest magnifying power, no structure could be distinguished; and it withstands for a considerable time the action of water. The nucleolus is situated on the middle of the *testis,* as Ehrenberg called this organ, or the nucleus, as it is termed by Von Siebold. The nucleus is about one-fifth of the entire length of the animalcule, and its breadth in the middle is about one-third of its length. Its longitudinal axis ordinarily coincides nearly, like that of the nucleolus, with the long axis of the animalcule. It is of ovate form; its substance displays no recognizable structure.

The nucleolus has very different characters in all the specimens of *Bursaria flava* I have hitherto observed. It was always so small that it was difficult to find it, and never became visible until the Infusorium was compressed, while in *Ophryoglena flavicans* it may usually be seen through the integuments. Its form is globular, and it presents no structure. It generally adheres firmly to the surface of the ovate nucleus.

The nucleus is not any larger in the rather larger specimens of *Bursaria flava* which possess two contractile vesicles. I met with some of them occasionally in company with the one-vesicled. They did not differ from the rest at all in shape, in the condition of the ciliary clothing, or in the formation of the mouth, so that I held them to be identical until I observed the second contractile vesicle, or the somewhat differently formed and smaller watch-glass-shaped organ; which last, in the specimens I have hitherto examined in respect to this point, had not a circular, but an elliptical base,—so far at least as a judgment can be formed from the mere aspect. Measurements made on one specimen gave—length of the animalcule, $\frac{4}{10}$ths of a millimetre; greatest thickness, $\frac{2}{10}$ths of a mill.; diameter of the globular nucleus, $\frac{7}{100}$ths of a mill.; of the nucleolus, $\frac{7}{1000}$ths of a mill.; distance of the mouth from the head-point, $\frac{12}{100}$ths of a mill.; distance of the contractile vesicles apart, $\frac{1}{10}$th of a mill.; of the hinder one from the tail-point, $\frac{7}{100}$ths of a mill.; greatest diameter of the base of the watch-glass-shaped organ, $\frac{7}{1000}$ths—smallest, $\frac{4}{1000}$ths of a millimetre.

The Vascular System.

This consists of two contractile vesicles, and a system of canals which open into them. The best subjects for the examination of these objects are usually found in those specimens of *Bursaria flava* which contain in their interior only the smallest forms of the strongly refractive granules. I frequently found such among the others in the pools of the Berlin Thiergarten. The contractile vesicles lie in the immediate vicinity of the mouth, a little behind it: if we conceive the animalcule to lie upon its back, with the mouth upwards and the end of the head turned away from the observer, the contractile vesicle will be placed to the left of the mouth, on its convex side, distant from it about a quarter of a circumference; when there are two vesicles, the anterior contractile vesicle lies exactly in the same spot, and the posterior is cut by a straight line drawn from the anterior vesicle to the tail-point. The position is just the same in the *Ophryoglenæ* above described. If we examine a *Bursaria* of this kind with a power of about 300 diameters, we perceive near the surface a quantity of light streaks, which run together towards the contractile vesicle from the anterior and posterior parts of the body, in more or less considerable curves. In each streak we detect an extremely delicate but perfectly distinct canal, terminating ultimately in the contractile vesicle; its walls and its contents are readily distinguished by their different refractive power. When one of these canals is traced backwards from its orifice, we may often perceive, after it has run a short distance, a ramification; this may frequently be traced to one of the extremities of the body, and sometimes it gives off another branch; ultimately the canals become so excessively fine, that they are invisible. Their opening into the vesicle and their course in running from it are seen very distinctly when the contractile vesicle is turned directly upwards; we may then recognize how the canals run between the contractile reservoirs, which lie very close to the surface of the body, and between the surfaces of the body inside the cortical substance; and the orifices may likewise be seen. Another remarkable position is when the nucleus is turned next the observer at the surface of the body; the canals are then seen remarkably clearly on its bright background. A few canals always run over directly, with a slight curvature, towards the posterior part of the mouth. When the animalcule lies so that the contractile vesicle appears at the margin of the body, there is sometimes an appearance as if one or more of the canals opened externally at this point; but close examination shows that they curve round and run towards other parts of the body.

The number of vessels opening into the contractile vesicle in *Bursaria flava* is about thirty; this number, or a few more or less, existed in all the specimens which I examined in reference to this point. They are apparently uniformly distributed over the whole surface.

The specimens of *Bursaria flava* with two contractile vesicles have the system of canals double, each system grouped independently around its reservoir. The canals of the posterior reservoir stretch into the district of the anterior; but I have never been able to detect any communication between the two. In the *Ophryoglenæ* from the Spree, very little could be detected of the canals, even when the interior of the body contained only slightly refractive substances. When a suitable specimen is somewhat compressed between the glasses, so that it cannot move about, the vessels are especially seen when they have the nucleus for a background, and when they end in the contractile vesicle.

I have never been able to trace any vessels into the interior of the body; for instance, towards the nucleus. I am also ignorant at present whether that part of the contractile vesicle which is turned toward the centre of the body of the animalcule receives any vessels.

Both *Bursaria flava* and *Ophryoglena flavicans* belong to those Infusoria in which the contractile reservoirs may assume the well-known stellate form. Von Siebold describes this phænomenon, in *Paramecium*, in the following words:—"These pulsating spaces have a very striking shape; they consist of two central round cavities, around which stand from five to seven smaller pear-shaped reservoirs, with points directed outwards, in the shape of a star. In the pulsation of these strange star-shaped reservoirs sometimes the stars disappear entirely, sometimes only the central round spaces, and sometimes only the rays." The opake *Bursariæ* exhibit this phænomenon just in the same way as it is described by Von Siebold; and those specimens in which the vascular system can be detected, offer the explanation of it. The small pear-shaped spaces are really the commencements of the vessels, which expand with the accumulated fluid, and the rays are the further prolongations of the same, which may be traced to the ends of the body.

At the moment when the contractile vesicle has attained the greatest expansion, that is, when the diastole is terminated, it appears in the form of a globe filled with colourless fluid, from which the vessels run out on all sides in the cortical substance as canals, apparently of equal diameter; they have at this time the smallest diameter they can assume at their embouchure into the reservoir. In opake specimens, this is the moment when the opened contractile vesicle is observed. A little before we observe the commencement of the systole, the vessels begin to expand slowly, at points distant about one diameter of the contractile vesicle from the surface of the latter, to many times their original size. The more the systole progresses, the wider and longer become the swollen places, and they approach gradually to the contractile vesicle. If we make an observation at the moment when the diameter of the contractile vesicle is diminished to about one-fourth of its original size, the shape of the apparatus agrees in all essential points with the well-known stellate figure, represented by Dujardin in *Paramecium Aurelia,* with the single exception that the embouchures of the rays are distinctly visible, and their peripheral prolongations run out widely in the form of canals over the entire animalcule. Opake specimens of the *Bursaria* display the phænomenon only in such a degree that the rays terminate in delicate attenuated points, at a distance of about one diameter of the reservoir from the latter. When the contractile vesicle has closed completely, the fusiformly expanded vessels only are seen, as they run together with their apices to one point. This completes the systole. The diastole then recommences. If we examine the animal at the moment when the reservoir has again attained half its greatest diameter, we find a totally different appearance from that at the corresponding epoch of the systole. The vessels are not expanded now in the form of a spindle, but of a funnel, with the base of the funnel in the contractile vesicle, and the point prolonged out into the vessel. This is the form which Ehrenberg has figured in *Paramecium Aurelia*, only omitting the further prolongations of the vessels; Von Siebold rejects Ehrenberg's figure, and recognizes Dujardin's; but both are really correct, only representing different instants; Dujardin gives a stage of the systole, Ehrenberg of the diastole.

The more the contractile vesicle now expands, the more is the depth of the funnel decreased, and its diameter proportionately increased; or, in other words, the vessel expands only at its embouchure, and the depth of the expanded part decreases in proportion with the advance of the diastole. In opake *Bursariæ*, we see at this time only the contractile vesicle produced out in various directions into short funnel-shaped processes. By degrees these processes entirely disappear, the contractile vesicle having expanded to its original volume. We now see again how, from the fully expanded contractile vesicle, the whole of the vessels run out in the cortical layer, in all directions, as slender streaks; in opake specimens, only the contractile reservoir is visible.

The processes above described are those usually observed when a suitable specimen is placed so that it cannot move, or only move very little, upon the slider. If, however, a *Bursaria* is compressed somewhat more with the covering-glass, or if the water on the slider is almost all evaporated, some other peculiar phænomena present themselves, not only in the contractile vesicle, but in the vessels. The last diastole coming perfectly to rest, and nothing unusual being observed, except that the reservoir is more elongated, with the systole appear suddenly two contractile vesicles instead of one; that is, a portion of the surrounding substance makes its way across the middle of the contractile vesicle while it is contracting, and thus divides it into two parts. Each of these two new reservoirs has its own systole and diastole. In most cases their contractions do not occur at the same moment. Each is in connexion with those vessels which opened into it before the separation. The vessels exhibit the same play as if there were but one uninjured contractile vesicle. Sometimes the two reservoirs reunite into a single one. I saw this happen during a diastole which occurred exactly simultaneously in both: they advanced near together, projected out points toward each other, which came in contact and formed a dumb-bell-shaped reservoir, and this was rapidly converted into a globular vesicle, which contracted and expanded as at the origin.

Von Siebold has already observed in *Phialina vermicularis, Bursaria cordiformis,* &c., "that in strong contractions of the whole body, a largish round pulsating space was drawn out longitudinally, constricted in the middle, and at length was separated into two smaller round spaces,—exactly as occurs when a drop of oil is separated into two portions." During the above-described alterations in the contractile vesicles, alterations ordinarily take place in the vessels also. Thus expansions appear in them at points lying very distant from the contractile reservoirs. These enlargements are not however subject to rhythmical disappearance and reappearance, but are permanent; they are filled with the same colourless fluid as the contractile vesicles, and are mostly globular or ellipsoidal. If such enlargements of the vessels are seen in specimens which, from unfavourable optical conditions, do not display the vessels themselves, they may be taken for vacuoles (in Dujardin's sense). Their connexion with the vessels, and their mode of origin, which is readily accessible to observation, prove that they are totally distinct from the vacuoles in the interior of the body, part of which contain nutrient substance, while part do not.

I have not succeeded in any case in isolating a membrane of the contractile reservoir or of the vessels. I find no trace of cilia in the interior of the vascular system. This alone suffices to distinguish essentially those Infusoria furnished with vessels, from the *Distoma*-embryo in which G. R. Wagener has discovered ciliated vessels.

Different hypotheses have been put forth in explanation of the function of the contractile vesicles. There is a detailed account of these in Claparède's paper on *Actinophrys**. Claparède rightly explains the contractile vesicles as organs of the circulation. As to the direction in which the fluid flows in the vessels, nothing can be directly observed in most cases, since we cannot perceive in the fluid any solid corpuscles at all similar to the blood-corpuscles of other animals. Is it a perfect circulation? or does the fluid flow back again in the same vessel in which it has been propelled forward by the contractile vesicle? or are the contents of the contractile vesicles constantly expelled externally? The last view has been set up by Oscar Schmidt. He states that he has seen the place of exit in the genera *Bursaria* and *Paramecium.* Claparède is opposed to this, since,

* Ann. and Mag. Nat. Hist. ser. 2, xv. p. 211.

in the most minute examination, he was unable to discover that the contents of the contractile vesicle were expelled externally in the systole. *Actinophrys* is better suited to the settlement of this question than a ciliated Infusorium. I have many times sought for currents in the fluid surrounding *Actinophrys Sol* and *A. Eichhornii,* when the fluid contained masses of fine globules immediately in front of the projection of the contractile reservoir; but I have never seen, any more than Claparède, any corresponding displacement when the vesicle contracted. In *Bursaria leucas, B. Vorticella, Paramecium Aurelia* and *P. Chrysalis,* I obtained the following results:—The contraction takes place exactly in the manner described by Schmidt; the vesicle contracts from the interior of the animalcule towards a point lying near the surface, and it expands on the entrance of the fluid in such a manner, that it increases in diameter gradually from the surface of the animalcule inwards toward the centre. But does this teach us what Schmidt concludes from it, that the reservoir expels its contents outwardly every time when it contracts toward the outside, and becomes filled from without when it expands toward the interior? If the contractile reservoir is attached by that part turned toward the surface of the animalcule, to the internal surface of the cortical substance, while the portion projecting into the interior of the body is free in the soft medullary mass,—will not the contraction take place from within outwardly, and the expansion from without inward, whether the fluid flow inwards or outwards? In *Actinophrys,* sometimes in *Arcella vulgaris,* and in *Urostyla grandis,* a totally different import must be attributed to the contractile reservoir, if Schmidt's criterion be valid; for here the reservoir does not contract toward the surface, but toward the interior of the body, and forms an elevation on the surface when it becomes filled, as described minutely in *Actinophrys* by both Von Siebold and Claparède. But it is not on this alone that Schmidt rests his opinion: he asserts that he has observed also an actual external orifice of the contractile vesicle. I must admit that *Bursaria Vorticella* has a distinct orifice at the hinder part of the body, and this exactly at the place to which the contractile vesicle contracts until it vanishes. But regarding this orifice which I saw, only so much is established, that it is the anal orifice which Ehrenberg has already described. I have seen the emergence of remains of devoured substances, of loricæ of Bacillariæ, of fine undeterminable granules, &c., from this very hole, so frequently, that there can be no doubt on this point; and it is even not rare for a corpuscle to slip out from the anal orifice during the diastole,—that is to say, at the very time when, according to Schmidt, the fluid should flow in from the outside. I found the *Bursaria* just named during spring and summer in standing water near Tempelhof; it agrees in the main with Ehrenberg's *Bursaria Vorticella*. The buccal orifice is situated as in *Bursaria truncatella,* in which however I did not observe any contractile vesicle at the posterior end of the body. The specimens of *B. truncatella* I observed were all about $\frac{1}{3}$rd of a line or more long, those of *B. Vorticella* at most $\frac{1}{9}$th of a line. The latter is in any case not a *Leucophrys*; therefore, in case Ehrenberg considers his *Bursaria Vorticella* a *Leucophrys,* it is a different animalcule from the latter. I was equally unable to satisfy myself of the correctness of Schmidt's view in the *Paramecia.* When a specimen of *Paramecium Aurelia* lies so that the contractile vesicle, either the anterior or posterior, is seen at the margin, it appears, under certain circumstances, as though a short canal ran directly out through the integument of the animalcule; but in reality it only runs into the integument, and turns round toward the side of the body directed away from the eye. I found the same in *Paramecium Chrysalis* also; it was always one of the rays of the contractile vesicle which presented to Schmidt the appearance of an external orifice. The same is the case in *Bursaria flava,* where I could always trace the curvature of the vessel toward the opposite side of the body most distinctly. F. Stein strongly questions the external opening of the contractile vesicle in the *Vorticellæ.* Hence it is clear, that the explanation of the contractile vesicles as part of a water-vascular system is unproven.

Is it however established, on the other hand, that the contractile reservoirs pour back their contents again into the parenchyma whence they receive it, as Von Siebold says? And if this is the case, how does it happen? Everything indicates most strongly that the contractile vesicles are filled out of the vessels during the diastole. We see how, during this process, the swollen part of the vessels near their embouchure gradually or suddenly return to their smallest diameter, as the stellate figure vanishes. And I have observed a part of a vessel inflated with the fluid, originating at the extreme end of the animalcule, traverse the whole distance up to the contractile vesicle during a single diastole. This phænomenon may be supposed to show that the absorbed fluid which had inflated the vessel into a globule, flowed during the said period into the contractile reservoir.

But if there is a fair presumption that the contractile vesicles are filled out of the vessels, the above observations teach us nothing whatever on the question as to where the fluid flows during the systole.

I have hitherto only become acquainted with one fact relating to this point. In *Bursaria Vorticella* we may detect the following fact: as soon as the contractile vesicle which lies at the posterior end of the body has contracted, we may observe at the margins of the animalcule, in its usual position of swimming, that two long narrow cavities originate, filled with transparent colourless fluid, and these stretch from opposite the mouth as far as the region of the contractile vesicle. They both gradually enlarge, and thus approach near to the anal point; here they meet, lose their often very irregular form, and change into the globular: the remaining contents of the body are displaced upwards by this; and then these globular reservoirs contract until they vanish, without it being perceptible where the fluid has been driven to; after some time the narrow light streaks reappear, and the process is repeated in the way above-described. The afferent canals, therefore, are not filled at the commencement of the systole. But must this not be so much the more expected, if the fluid flowed back in the same path as it came in, the vanishing of the contractile vesicle taking place much more rapidly than its production?

I have never yet found in any Infusorium special canals in which the fluid is seen to flow back into the body during the systole, and which would give the means of a perfect circulation.

The facts stated in this paper were first made public at the meeting of the Berlin "Naturforschende Freunde," June 19, 1855.

XXIX.—*New British* Arthoniæ.

By the Rev. W. A. Leighton, B.A., F.B.S.E.

[With a Plate.]

Since the publication of my Monograph of British *Graphideæ*, the following species of *Arthonia*, new to our flora, have occurred to my notice.

1. *Arthonia glaucomaria*, Nyl. Thallus none; ardellæ hymenicolar, sessile, round; disk black, flattened, more or less convex, dull; sporidia in asci, eight, oblong, 1- 2- 3-septate.

Arthonia glaucomaria, Nyl. Nouv. Class. Lich. (2 Mém.) in Mém. Soc. Sc. Nat. Cherbourg, 3. 189 (1855); Syn. Arthoniarum in Mém. Soc. Sc. Nat. Cherbourg, 4. 98; Leight. Lich. Brit. Exsic. 247!

Parasitic on the apothecia of *Lecanora glaucoma*, Ach.

Haughmond Hill! Caer Caradoc! and Long Mynd! Shropshire. Barmouth! N. Wales. Cliffrigg, Cleveland, Yorkshire!

Thallus undistinguishable from that of the matrix. *Ardellæ*